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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/464,322	12/15/1999	HEUNG-KYU KWON	AB-881US	7367

24251 7590 11/19/2002

SKJERVEN MORRILL LLP
25 METRO DRIVE
SUITE 700
SAN JOSE, CA 95110

EXAMINER	
CHU, CHRIS C	
ART UNIT	**PAPER NUMBER**
2815	

DATE MAILED: 11/19/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/464,322	KWON ET AL.	
	Examiner	Art Unit	
	Chris C. Chu	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 August 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *2 - 15 and 17 - 20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *2 - 15 and 17 - 20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Response to Amendment

1. Applicant's amendment filed on August 27, 2002 has been received and entered in the case.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 3, 5, 6, 8, 9, 11, 12, 14, 17 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hawthorne et al. in view of Maheshwari et al.

Regarding claim 3, Hawthorne et al. discloses in Fig. 3 a semiconductor chip package comprising:

- a substrate (40, 50a and 50b) having a plurality of bonding pads;

- a semiconductor chip (44) having a plurality of conductive bumps (54) on a front side thereof (see Fig. 3), the conductive bumps (54) contacting the bonding pads (see Fig. 3);
- a heat slug (66) bonded to a backside of the semiconductor chip (see Fig. 3); and a solder film (71) directly attached to the heat slug (66) thereby bonding the heat slug to the backside of the semiconductor chip (see Fig. 3).

Hawthorne et al. does not disclose the backside of the semiconductor chip including a metal layer formed thereon for strengthening adhesion between the semiconductor chip and the solder film. However, Maheshwari et al. discloses the backside of the semiconductor chip including a metal layer (balance plate) formed thereon for strengthening adhesion between the semiconductor chip and the solder film (see Fig. 2). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Hawthorne et al. by adding the metal layer on the backside of the semiconductor chip as taught by Maheshwari et al. The ordinary artisan would have been motivated to modify Hawthorne et al. in the manner described above for at least the purpose of minimizes substrate and die warpage induced after underfill cure operations (read column 1, lines 66 and 67). As to the language on lines 2 and 3 of claim 3, "formed thereon for strengthening adhesion between the semiconductor chip and the solder film", applicant should note that this is merely "result or function" language which cannot be relied upon to define over Hawthorne et al., since Hawthorne et al. discloses all of the claimed elements. Further, the recitation "a plurality of bonding pads" is structurally inherent in Hawthorne et al. Furthermore, since Hawthorne et al. does not limit the adhesive to any

particular or specific adhesive, his/her disclosure encompasses all well known adhesives including "solder film."

Regarding claim 5, Hawthorne et al. discloses the claimed invention except for an underfilling material to fill a space between the semiconductor chip and the substrate. However, Fig. 2 of Maheshwari et al. clearly shows that an underfilling material is filled between the semiconductor chip and the substrate. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Hawthorne et al. by adding the underfilling material between the semiconductor chip and the substrate as taught by Maheshwari et al. The ordinary artisan would have been motivated to modify Hawthorne et al. in the manner described above for at least the purpose of preventing the cracking of the conductive bumps.

Regarding claims 6 and 17, note Fig. 3 of Hawthorne et al., where he/she clearly shows that the solder film (71) has a size equal to or larger than a size of the semiconductor chip (44).

Regarding claim 8, Hawthorne et al. discloses the claimed invention except for the heat slug comprises an adhesion layer formed on a surface of the heat slug that contacts the solder film. However, Maheshwari et al. discloses the heat slug comprises an adhesion layer (balance plate) formed on a surface of the heat slug that contacts the solder film (see Fig. 2). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Hawthorne et al. by adding the adhesion layer on a surface of the heat slug that contacts the solder film as taught by Maheshwari et al. The ordinary artisan would have been motivated to modify Hawthorne et al. in the manner described above for at least the purpose of minimizes substrate and die warpage induced after underfill cure operations (read column 1, lines 66 and 67). Further, since the term "adhesion layer (14 in Fig. 1 of instant invention)" is a multi-layer

metal structure (read page 3, lines 8 ~ 10 of amended specification), Maheshwari et al. discloses the adhesion layer.

Regarding claim 9, Hawthorne et al. discloses the claimed invention except for the adhesion layer is a layer selected from a group consisting of a Ni/Au layer, a Ag layer, and a Pd layer. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to using the Ni/Au layer, Ag layer, or Pd layer for the adhesion layer, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. The ordinary artisan would have been motivated to modify Hawthorne et al. in the manner described above for at least the purpose of increasing the bond strength between the heat slug and the solder film. In re Leshin, 125 USPQ 416.

Regarding claim 11, note Fig. 3 of Hawthorne et al., where he/she clearly shows that a portion of the heat slug (66) is attached to the substrate (40, 50a and 50b).

Regarding claim 12, Hawthorne et al. discloses the claimed invention except for the adhesive includes silicon rubber or elastomer. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to using silicon rubber or elastomer material for the adhesive, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. The ordinary artisan would have been motivated to modify Hawthorne et al. in the manner described above for at least the purpose of increasing the bond strength between the heat slug and the substrate. In re Leshin, 125 USPQ 416.

Regarding claim 14, the method steps are disclosed by Hawthorne et al. in view of Maheshwari et al. for the same reasons provided above with regard to claim 3.

Regarding claim 19, Hawthorne et al. discloses in Fig. 3 a semiconductor chip package comprising:

- a substrate (40, 50a and 50b) having a plurality of bonding pads (see Fig. 3);
- a semiconductor chip (44) having a plurality of conductive bumps (54) on a front side thereof, the conductive bumps (54) contacting the bonding pads (see Fig. 3);
- a heat slug (66) bonded to the semiconductor chip (see Fig. 3), the heat slug (66) comprising a top portion, side standing portions bent from the top portion, and side end portions bent again from the side standing portions (see Fig. 3); and
- a solder film (71) that bonds the heat slug (66) to the backside of the semiconductor chip (see Fig. 3), wherein the top portion of the heat slug (66) contacts the conductive solder film (71) and the side end portions (70) of the heat slug (66) are attached to the substrate (40, 50a and 50b) by an adhesive (62 and see Fig. 3).

Hawthorne et al. does not disclose the heat slug comprising an adhesion layer formed on a surface of the heat slug that contacts the solder film. However, Maheshwari et al. discloses the heat slug comprising an adhesion layer (balance plate) formed on a surface of the heat slug that contacts the solder film (see Fig. 2). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Hawthorne et al. by adding the adhesion layer on a surface of the heat slug that contacts the solder film as taught by Maheshwari et al. The ordinary artisan would have been motivated to modify Hawthorne et al. in the manner described above for at least the purpose of minimizes substrate and die warpage induced after

underfill cure operations (read column 1, lines 66 and 67). Further, since the term "adhesion layer (14 in Fig. 1 of instant invention)" is a multi-layer metal structure (read page 3, lines 8 ~ 10 of amended specification), Maheshwari et al. discloses the adhesion layer. Further, the recitation "a plurality of bonding pads" is structurally inherent in Hawthorne et al. Furthermore, since Hawthorne et al. does not limit the adhesive to any particular or specific adhesive, his/her disclosure encompasses all well known adhesives including "solder film."

4. Claims 2 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hawthorne et al. and Maheshwari et al. as applied to claim 3 above, and further in view of Haley.

Regarding claim 2, Hawthorne et al. discloses the claimed invention except for the material of the solder film, which includes one selected from "a group consisting of Pb, Sn, Ag, In, and Bi." However, Haley discloses the material of the solder film (column 3, lines 66 –67). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Hawthorne et al. by selecting from a group consisting of Pb, Sn, Ag, In, and Bi for the material of the solder film as taught by Haley. The ordinary artisan would have been motivated to further modify Hawthorne et al. in the manner described above for at least the purpose of increasing the bond strength between the semiconductor chip and the heat slug.

Regarding claim 13, Hawthorne et al. discloses the claimed invention except for a plurality of "throughholes" on the heat slugs. However, Haley discloses the plurality of "throughholes" on the heat slugs (108 and 109 in Fig. 1). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Hawthorne et al. by adding the plurality of "throughholes" on the heat slugs as taught by Haley. The ordinary

artisan would have been motivated to further modify Hawthorne et al. in the manner described above for at least the purpose of decreasing moisture inside of the package.

5. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hawthorne et al. in view of Maheshwari et al. as applied to claim 3 above, and further in view of Furukawa et al.

Hawthorne et al. discloses the claimed invention except for the material of the metal layer, which includes one selected from "a group consisting of VNi/Au, Ti/VNi/Au, Cr/Vni/Au, Ti/Pt/Au, and etc." However, Furukawa et al. discloses the material of the metal layer (column 9, lines 63 –64). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Hawthorne et al. by selecting from a group consisting of VNi/Au, Ti/VNi/Au, Cr/Vni/Au, Ti/Pt/Au, and etc for the material of the metal layer as taught by Furukawa et al. The ordinary artisan would have been motivated to further modify Hawthorne et al. in the manner described above for at least the purpose of increasing the bond strength between the semiconductor chip and the solder film.

6. Claims 7 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hawthorne et al. and Maheshwari et al. as applied to claims 3 and 19 above, and further in view of Takahama et al.

Regarding claims 7 and 18, Hawthorne et al. discloses the claimed invention except that the heat slug is formed of a material selected from a group consisting of Cu, Al, and CuW. However, Takahama et al. discloses that the material of the heat slug (column 6, lines 38 – 39). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was

made to further modify Hawthorne et al. by selecting from a group consisting as of Cu, Al, and CuW as taught by Takahama et al. The ordinary artisan would have been motivated to further modify Hawthorne et al. in the manner described above for at least the purpose of improving heat dissipation.

7. Claims 10 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hawthorne et al. and Maheshwari et al. as applied to claims 3 and 19 above, and further in view of Jeong et al.

Regarding claims 10 and 20, Hawthorne et al. discloses the claimed invention except for the heat slug is coated with an anodizing layer on a surface of the heat slug that is opposite to another surface of the heat slug, on which the semiconductor chip is bonded. However, Jeong et al. discloses that the anodizing layer (73b in Fig. 6 and column 8, lines 2 – 5 and read column 7, lines 65 ~ 67) on a surface of the heat slug (73) that is opposite to another surface of the heat slug, on which the semiconductor chip is bonded (see Fig. 6). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Hawthorne et al. by adding the anodizing layer as taught by Jeong et al. The ordinary artisan would have been motivated to further modify Hawthorne et al. in the manner described above for at least the purpose of increasing the corrosion resistant and electrical insulation.

8. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hawthorne et al. and Maheshwari et al. as applied to claim 14 above, and further in view of Wang et al.

Hawthorne et al. discloses the claimed invention except for the filling a resin into a space between the semiconductor chip and the substrate. However, Wang et al. discloses in Fig. 3 and column 4, lines 31 ~ 45 that filling a resin into a space between the semiconductor chip and the substrate. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further modify Hawthorne et al. by filling a resin into a space between the semiconductor chip and the substrate as taught by Wang et al. The ordinary artisan would have been motivated to further modify Hawthorne et al. in the manner described above for at least the purpose of increasing the attachment between the semiconductor chip and the substrate.

Response to Arguments

9. Applicant's arguments filed on August 27, 2002 have been fully considered but they are not persuasive.

On page 7, applicant argues "Hawthorne et al. and Maheshwari et al. teach away from combination with one another because Hawthorne et al. discloses no flexible substrate coupled directly to the bottom of the die from which the balance plate would counteract the force and minimize warpage. ... Therefore, Hawthorne et al. teaches away from adding a metal layer to the backside of a semiconductor chip as taught by Maheshwari et al. in order to minimize substrate and die warpage induced after underfill cure operations." The argument is not persuasive because the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined

teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981).

Further, in response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the motivation was well known in the art (increasing the bond strength between the semiconductor chip and the heat slug for claim 2 and decreasing moisture inside of the package for claim 13). Further, applicant should be noted that the only teaching the examiner is relying on from the disclosure of Haley is the teaching of the material of solder for the solder film defined in claim 2. Therefore, arguments thereagainst are not deemed to be relevant to how Haley is applied in the rejection.

Finally, in response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir.

1992). In this case, the motivation was established by Maheshwari et al., specifically in read column 1, lines 66 and 67 (minimizes substrate and die warpage induced after underfill cure operations).

For the above reasons the rejection is maintained.

Conclusion

10. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is (703) 305-6194. The examiner can normally be reached on M-F (10:30 - 7:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on (703) 308-1690. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7382 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Chris C. Chu
Examiner
Art Unit 2815

c.c.
November 6, 2002

EDDIE LEE
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800